Hemorrhagic Versus Ischemic Stroke

KEY TEACHING POINTS

- Ischemic and hemorrhagic strokes may both cause neurologic deficits such as hemiparesis, hemisensory deficit, aphasia, and hemianopia. Certain *additional* findings, however, may distinguish hemorrhagic from ischemic stroke.
- In studies of patients with stroke, the findings that *increase* probability of hemorrhagic stroke the most are coma, neurologic deterioration during the first 3 hours, neck stiffness, systolic blood pressure greater than 220 mm Hg, and a Siriraj score greater than 1.
- In patients with stroke, the findings that *decrease* probability of hemorrhagic stroke the most are cervical bruit, atrial fibrillation, and a Siriraj score of less than −1.
- Despite the value of these bedside findings, all patients with stroke require urgent neuroimaging to distinguish these subtypes and direct management.

I. INTRODUCTION

Stroke is the third leading cause of death in the United States.[1] The two fundamental subtypes of strokes are **hemorrhagic stroke** (intracerebral hemorrhage or subarachnoid hemorrhage) and **ischemic stroke** (infarction from thrombosis or embolism). In the United States, 87% of strokes are ischemic and 13% are hemorrhagic (10% are intracerebral and 3% are subarachnoid),[1] but in some developing nations more than 50% of strokes are hemorrhagic.[2] All patients with stroke require prompt neuroimaging to distinguish these subtypes and direct management, although bedside examination is still helpful when neuroimaging is unavailable and while monitoring patients during treatment.[3]

Since the times of ancient Babylonia, Greece, and Rome, clinicians have recognized stroke, calling it *apoplexy*.[4,5] Although ancient physicians understood that damage to one cerebral hemisphere produced weakness on the opposite side of the body, modern concepts of cerebrovascular disease were lacking until 1655, when Johann Jakob Wepfer, a Swiss physician, first described intracranial hemorrhage, its clinical features, and postmortem findings.[6]

II. FINDINGS

Cerebral hemorrhage and infarction cause abrupt *deficits* of neurologic function, such as hemiparesis, aphasia, hemisensory disturbance, ophthalmoplegia, visual
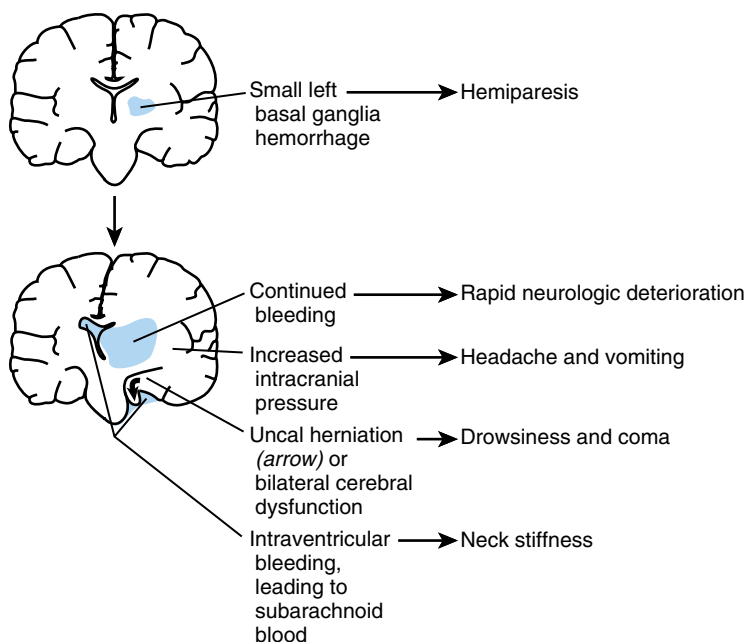
FIG. 67.1 "ADDITIONAL" FINDINGS OF HEMORRHAGIC STROKE (CORONAL SEC-
TION OF BRAIN). *Top half:* There is a small hemorrhage in the left basal ganglia, causing hemipa-
resis and clinical findings indistinguishable from ischemic stroke. *Bottom half:* Progressive intracranial
hemorrhage causes the "additional" findings of hemorrhage, including rapid neurologic deteriora-
tion, headache, vomiting, coma, and neck stiffness. Intraventricular blood follows the normal path
of cerebrospinal circulation through the median and lateral apertures of the fourth ventricle to reach
the subarachnoid space at the base of the brain (only rarely does intracerebral hemorrhage directly
rupture in the subarachnoid space).

field defects, and ataxia. Nonetheless, cerebral hemorrhage differs from infarction
by the presence of an *expanding* hemorrhage within the brain, which may produce
additional symptoms beyond neurologic deficits (Fig. 67.1). Examples of additional
symptoms are prominent vomiting (from increased intracranial pressure), severe
headache (from meningeal irrigation or increased intracranial pressure), rapid
progression of neurologic deficits (from expansion of the hematoma), coma (from
bilateral cerebral dysfunction, uncal herniation, or posterior fossa mass effect), and
bilateral Babinski signs (from bilateral dysfunction).

Over the last several decades, clinicians have developed several different stroke
scores to distinguish hemorrhagic from ischemic infarction,[3] but the most widely
used is the Siriraj stroke score, developed by Poungvarin et al.[7] in 1991 (Table 67.1).

III. CLINICAL SIGNIFICANCE

The data in EBM Boxes 67.1 and 67.2 stem from analysis of 39 studies involving more
than 11,000 patients with stroke from across the globe. The diagnosis of hemorrhagic
stroke in these studies includes intracranial and subarachnoid hemorrhage, although
relatively few patients had subarachnoid hemorrhage. The diagnostic accuracy of
bedside findings is the same if patients with subarachnoid hemorrhage are excluded.[3]

TABLE 67.1 Siriraj Stroke Score*

Characteristic	Points
Mental status[†]	
Coma, semicoma	+ 5
Drowsy, stupor	+ 2.5
Vomiting	+ 2
Headache within 2 h	+ 2
Diastolic blood pressure	+ 0.1 × DBP in mm Hg
Diabetes, angina, or intermittent claudication	− 3
Correction factor	− 12

DBP, Diastolic blood pressure.
*Based upon reference 7. Interpretation of total score: >1 hemorrhage; −1 to 1 uncertain; < −1 infarction.
[†]*Alert mental status* receives 0 points.

EBM BOX 67.1
*Hemorrhagic Stroke**

| Finding (Reference)[†]	Sensitivity (%)	Specificity (%)	Likelihood Ratio[‡] if Finding Is	
			Present	Absent
Vital Signs				
Systolic BP >220 mm Hg[8]	17	96	**4.0**	NS
Systolic BP <160 mm Hg[9]	29	30	0.4	2.4
Additional Findings				
Mental status[7,10-15]				
Coma	18-51	90-99	**6.3**	—
Drowsy	17-59	—	1.7	—
Alert	21-54	21-41	0.5	—
Neurologic deterioration during first 3 h[16]	77-81	85-88	**5.8**	**0.2**
Kernig or Brudzinski sign[16,17]	3-15	98	NS	NS
Neck stiffness[2,7,9,16-18]	16-48	81-98	**5.4**	0.7
Babinski response[7,18,19]				
Both toes extensor	12-22	90-95	2.4	—
Single toe extensor	30-73	—	NS	—
Both toes flexor	8-48	40-75	0.5	—
Neurologic Deficits				
Deviation of eyes[11,12,18,19]	27-62	64-81	1.9	0.7
Hemiparesis[10-12,18-21]	17-87	12-73	NS	NS
Aphasia[11,12,18,22]	12-35	62-92	NS	NS
Hemisensory disturbance[10-12,18,19]	0-80	40-98	1.3	NS

Continued

EBM BOX 67.1
Hemorrhagic Stroke—cont'd*

Finding (Reference)[†]	Sensitivity (%)	Specificity (%)	Likelihood Ratio[‡] if Finding Is Present	Absent
Neurologic Deficits, cont.				
Hemianopia[11,12]	35	73	1.3	NS
Ataxia[11,12]	15	80	NS	NS
Other Findings				
Cervical bruit[9,12,13]	1	81-93	**0.1**	NS
Atrial fibrillation on ECG[10,16,18,19,23]	1-21	60-91	**0.3**	1.3

*Diagnostic standard: For *hemorrhagic stroke*, computed tomography (all studies), sometimes with magnetic resonance imaging[14,24] or autopsy.[14,25]
[†]Definition of findings: For *both toes extensor*, the Babinski response is *present* on both feet; for *both toes flexor*, the Babinski response is *absent* in both feet.
[‡]Likelihood ratio (LR) if finding present = positive LR; LR if finding absent = negative LR.
BP, Blood pressure; *ECG,* electrocardiogram; *NS,* not significant.
Click here to access calculator

HEMORRHAGIC STROKE
Probability
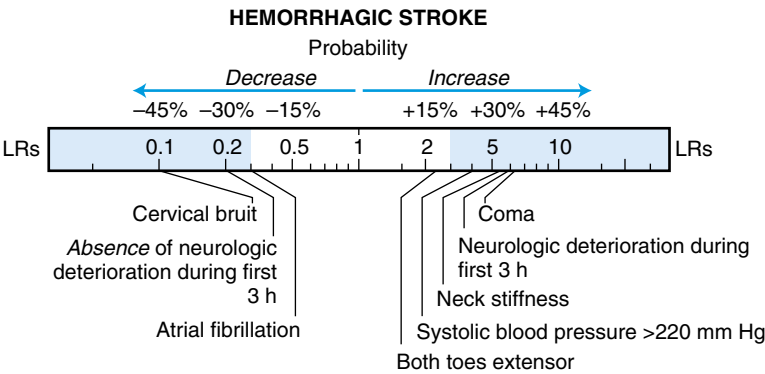
A. SYMPTOMS

According to a systematic review,[3] the following symptoms increase the probability of hemorrhagic stroke: seizures accompanying the neurologic deficit (likelihood ratio [LR] = 4.7), vomiting (LR = 3), headache (LR = 2.9), and loss of consciousness (LR = 2.6). A history of prior transient ischemic attack decreases the probability of hemorrhagic stroke (LR = 0.3).

B. INDIVIDUAL PHYSICAL FINDINGS

According to the LRs in EBM Box 67.1, the physical findings that increase the probability of hemorrhagic stroke the most are coma (LR = 6.3), neurologic deterioration during the first 3 hours (LR = 5.8), neck stiffness (LR = 5.4), systolic blood pressure greater than 220 mm Hg (LR = 4), and Babinski response in both toes (LR = 2.4).

EBM BOX 67.2
Siriraj Score for Hemorrhagic Stroke*

Finding (Reference)[†]	Sensitivity (%)	Specificity (%)	Likelihood Ratio[‡] if Finding Is	
			Present	Absent
Siriraj score "hemorrhage" (>1)	23-87	65-99	**5.5**	—
Siriraj score "uncertain" (−1 to 1)	1-51		NS	—
Siriraj score "infarction" (<−1)	3-53	13-60	**0.3**	—

*Based on references.[2,7,16-18,20,25-42]
[†]For calculation of *Siriraj score,* see Table 67.1.
[‡]Likelihood ratio (LR) if finding present = positive LR; LR if finding absent = negative LR.
Click here to access calculator

HEMORRHAGIC STROKE: SIRIRAJ SCORE
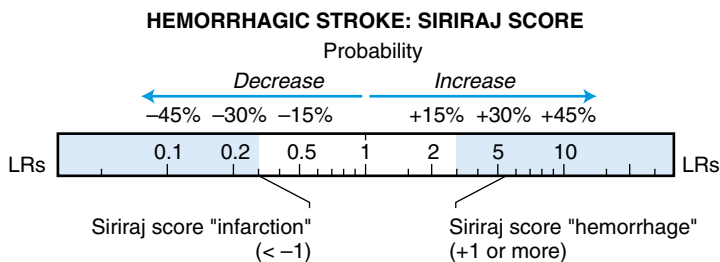
The findings that decrease the probability of hemorrhagic stroke the most are cervical bruit (LR = 0.1), absence of neurologic deterioration during the first 3 hours (LR = 0.2), and the presence of atrial fibrillation (LR = 0.3).

As expected (see the section on Findings), the presence or absence of neurologic *deficits*—hemiparesis, hemisensory disturbance, deviation of eyes, aphasia, hemianopia, and ataxia—fail to distinguish hemorrhagic from ischemic stroke.

C. COMBINED FINDINGS (SIRIRAJ STROKE SCORE)

A Siriraj stroke score of greater than 1 (hemorrhage) increases the probability of hemorrhagic stroke (LR = 5.5, see EBM Box 67.2), whereas a score of less than −1 (infarction) decreases the probability (LR = 0.3). Nonetheless, in these studies an average of 20% of patients with stroke (range 8% to 48%) were classified as "uncertain" by the Siriraj score, a score lacking diagnostic value (LR is not significant).

The references for this chapter can be found on www.expertconsult.com.

This page intentionally left blank

REFERENCES

1. Lloyd-Jones D, Adams RJ, Brown TM, et al. Heart disease and stroke statistics 2010 update: a report from the American Heart Association. *Circulation*. 2010;121:e46–e215.
2. Zenebe G, Asmera J, Alemayehu M. How accurate is Siriraj stroke score among Ethiopians? A brief communication. *Ethiop Med J*. 2005;43:35–38.
3. Runchey S, McGee SR. Does this patient have a hemorrhagic stroke?: clinical findings distinguishing hemorrhagic stroke from ischemic stroke. *J Am Med Assoc*. 2010;303(22):2280–2286.
4. Schutta HS. Morgagni on apoplexy in *De Sedibus*: a historical perspective. *J Hist Neurosci*. 2009;18:1–24.
5. Reynold EH, Wilson JVK. Stroke in Babylonia. *Arch Neurol*. 2004;61:597–601.
6. Major R. *Classic Descriptions of Disease: with Biographical Sketches of the Authors*. Springfield, IL: Charles C Thomas; 1932.
7. Poungvarin N, Viriyavejakul A, Komontri C. Siriraj stroke score and validation study to distinguish supratentorial intracerebral haemorrhage from infarction. *Br Med J*. 1991;302:1565–1567.
8. Panzer RJ, Feibel JH, Barker WH, Griner PF. Predicting the likelihood of hemorrhage in patients with stroke. *Arch Intern Med*. 1985;145:1800–1803.
9. Harrison MJG. Clinical distinction of cerebral haemorrhage and cerebral infarction. *Postgrad Med J*. 1980;56:629–632.
10. Bogousslavsky J, Van Melle G, Regli F. The Lausanne stroke registry: analysis of 1000 consecutive patients with first stroke. *Stroke*. 1988;19:1083–1092.
11. Foulkes MA, Wolf PA, Price TR, Mohr JP, Hier DB. The stroke data bank: design, methods, and baseline characteristics. *Stroke*. 1988;19:547–554.
12. Massaro AR, Sacco RL, Scaff M, Mohr JP. Clinical discriminators between acute brain hemorrhage and infarction: a practical score for early patient identification. *Arq Neuropsiquiatr*. 2002;60(2-A):185–191.
13. Shah FU, Salih M, Saeed MA, Tariq M. Validity of Siriraj stroke scoring. *J Coll Physic Surg Pak*. 2003;13(7):391–393.
14. Akpunonu BE, Mutgi AB, Lee L, Khuder S, Federman DJ, Roberts C. Can a clinical score aid in early diagnosis and treatment of various stroke syndromes? *Am J Med Sci*. 1998;315(3):194–198.
15. Harrison MJG. Clinical distinction of cerebral haemorrhage and cerebral infarction. *Postgrad Med J*. 1980;56:629–632.
16. Efstathiou SP, Tsioulos DI, Zacharos ID, et al. A new classification tool for clinical differentiation between haemorrhagic and ischaemic stroke. *J Intern Med*. 2002;252:121–129.
17. Nyandaiti YW, Bwala SA. Validation study of the Siriraj stroke score in North-east Nigeria. *Nig J Clin Pract*. 2008;11(3):176–180.
18. Stürmer T, Schlindwein G, Kleiser B, Roempp A, Brenner H. Clinical diagnosis of ischemic versus hemorrhagic stroke: applicability of existing scores in the emergency situation and proposal of a new score. *Neuroepidemiology*. 2002;21:8–17.
19. Besson G, Robert C, Hommel M, Perret J. Is it clinical possible to distinguish nonhemorrhagic infarct from hemorrhagic stroke? *Stroke*. 1995;26:1206–1209.
20. Nouira S, Boukef R, Bouida W, et al. Accuracy of two scores in the diagnosis of stroke subtype in a multicenter cohort study. *Ann Emerg Med*. 2009;53:373–378.
21. Shigematsu K, Shimamura O, Nakano H, et al. Vomiting should be a prompt predictor of stroke outcome. *Emerg Med J*. 2013;30:728–731.
22. Woisetschläger C, Kittler H, Oschatz E, et al. Out-of-hospital diagnosis of cerebral infarction versus intracranial haemorrhage. *Intensive Care Med*. 2000;26:1561–1565.
23. Yamashita S, Kimura K, Iguchi Y, Shibazaki K, Watanabe M, Iwanaga T. Kurashiki Prehospital Stroke Subtyping Score (KP3S) as a means of distinguishing ischemic from hemorrhagic stroke in emergency medical services. *Eur Neurol*. 2011;65:233–238.
24. Saposnik G, Caplan LR, Gonzalez LA, et al. Differences in stroke subtypes among natives and caucasians in Boston and Buenos Aires. *Stroke*. 2000;31:2385–2389.
25. Weir CJ, Murray GD, Adams FG, Muir KW, Grosset DG, Lees KR. Poor accuracy of stroke scoring systems for differential clinical diagnosis of intracranial haemorrhage and infarction. *Lancet*. 1994;344:999–1002.

26. Wadhwani J, Hussain R, Raman PG. Nature of lesion in cerebrovascular stroke patients: clinical stroke score and computed tomography scan brain correlation. *J Assoc Phys India*. 2002;50:777–781.
27. Soman A, Joshi SR, Tarvade S, Jayaram S. Greek stroke score, Siriraj score and Allen score in clinical diagnosis of intracerebral hemorrhage and infarct: validation and comparison study. *Ind J Med Sci*. 2004;58(10):417–422.
28. Ozeren A, Bicakci S, Burgut R, Sarica Y, Bozdemir H. Accuracy of bedside diagnosis versus Allen and Siriraj stroke scores in Turkish patients. *Eur J Neurol*. 2006;13:611–615.
29. Ogun SA, Oluwole O, Fatade B, Ogunseyinde AO, Ojini FI, Odusote KA. Comparison of Siriraj stroke score and the WHO criteria in the clinical classification of stroke subtypes. *Afr J Med Med Sci*. 2002;31(1):13–16.
30. Ng PW, Sha KY. Clinical stroke scores in Chinese population. *Stroke*. 1996;27(4):773.
31. Kolapo KO, Ogun SA, Danesi MA, Osalusi BS, Odusote KA. Validation study of the siriraj stroke score in African Nigerians and evaluation of its discriminant values of its parameters: a preliminary prospective CT scan study. *Stroke*. 2006;37:1997–2000.
32. Kochar DK, Joshi A, Agarwal N, Aseri S, Sharma BV, Agarwal TD. Poor diagnostic accuracy and applicability of Siriraj stroke score, Allen score and their combination in differentiating acute haemorrhagic and thrombotic stroke. *J Assoc Physic India*. 2000;48:584–588.
33. Kan CH, Lee SK, Low CS, Velusamy SS, Cheong I. A validation study of the Siriraj stroke score. *Int J Clin Pract*. 2000;54(10):645–646.
34. Ilić T, Jovicić A, Lepić T, Magdić B, Cirković S. Cerebral infarction vs. intracranial hemorrhage: validity of clinical diagnosis. *Vojnosanit Pregl*. 1997;54(4):299–309.
35. Hung LY, Wang PY, Wang Y, Chia LG. Clinical distinction between acute hemorrhagic and acute ischemic stroke by Siriraj stroke score. *Chin Med J*. 1995;55:248–252.
36. Hui ACF, Wu B, Tang ASY, Kay R. Lack of clinical utility of the Siriraj stroke score. *Intern Med J*. 2002;32:311–314.
37. Hawkins GC, Bonita R, Broad JB, Anderson NE. Inadequacy of clinical scoring systems to differentiate stroke subtypes in population-based studies. *Stroke*. 1995;26:1338–1342.
38. Daga MK, Sarin K, Negi VS. Comparison of Siriraj and Guy's hospital score to differentiate supratentorial ischaemic and haemorrhagic strokes in the Indian population. *J Assoc Physic India*. 1994;42(4):302–303.
39. Connor MD, Modi G, Warlow CP. Accuracy of the Siriraj and Guy's hospital stroke scores in urban South Africans. *Stroke*. 2006;38(1):62–68.
40. Celani MG, Righetti E, Migliacci R, et al. Comparability and validity of two clinical scores in the early differential diagnosis of acute stroke. *Br Med J*. 1994;308:1674–1676.
41. Badam P, Solao V, Pai M, Kalantri SP. Poor accuracy of the Siriraj and Guy's hospital stroke scores in distinguishing haemorrhagic from ischaemic stroke in a rural, tertiary care hospital. *Nat Med J Ind*. 2003;16(1):8–12.
42. Goswami RP, Karmakar PS, Ghosh A. Bedside utility of clinical scoring systems in classifying stroke. *Ind J Med Sci*. 2013;67:137–145.